Space Weather Technical Forecast

Issued on Thursday, 05 October 2023 at 13:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Chance of M-flares throughout. Slight chance of an isolated G1/Minor Storm interval on Day 2 (06 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity is Low, with minor C-class flares observed in the last 24 hours. There are nine sunspot regions on the visible disc. AR3452 north centre disc is the largest, however it still has a fairly straightforward magnetic structure. AR3451 just to the north of AR3452 has penumbra on the trailing spot. AR3450 is relatively unchanged in the southwest. The other regions appear mostly small and simple at the present time. No new Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as observed by DSCOVR and ACE at L1, were mostly slightly elevated with an upward trend observed and solar winds have now reached around 440 km/s. Density was near or slight above average. The interplanetary magnetic field, Bt, was weak to moderate, peaking at 9nT. The north-south component, Bz, varied between +6/-8nT but was mostly southward directed. Phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet to Active (Kp1-4) with an unexpected G1/minor storm (Kp5) interval recorded between 05/0300UTC to 05/0600UTC, and perhaps related to the incoming HSS.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was mostly at background levels. Associated 24-hour fluence was below the Active (1e8 integrated pfu) threshold with a mostly level trend. The observation at 05/0000 UTC was 2.62e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low solar activity is expected to continue for much of the four-day period, with a chance of isolated M-class flares. The greatest risk of this coming from AR3452 which is currently centre-disc.

Solar Wind / Geomagnetic Activity: A coronal dimming event observed to be starting at 02/1554 UTC may have resulted in a faint, rather slow Earth-directed CME. Confidence is low in both the likelihood of this feature reaching Earth, and in the timing of any arrival. This may arrive at Earth either late on Day 1 (05 Oct) or more likely in the first half of Day 2 (06 Oct). No other CMEs feature in the forecast. No significant high-speed stream enhancements are forecast. Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp1-3). This may become Active (Kp4) should the aforementioned CME arrive, with a slight chance of G1/Minor Storm interval (Kp5).

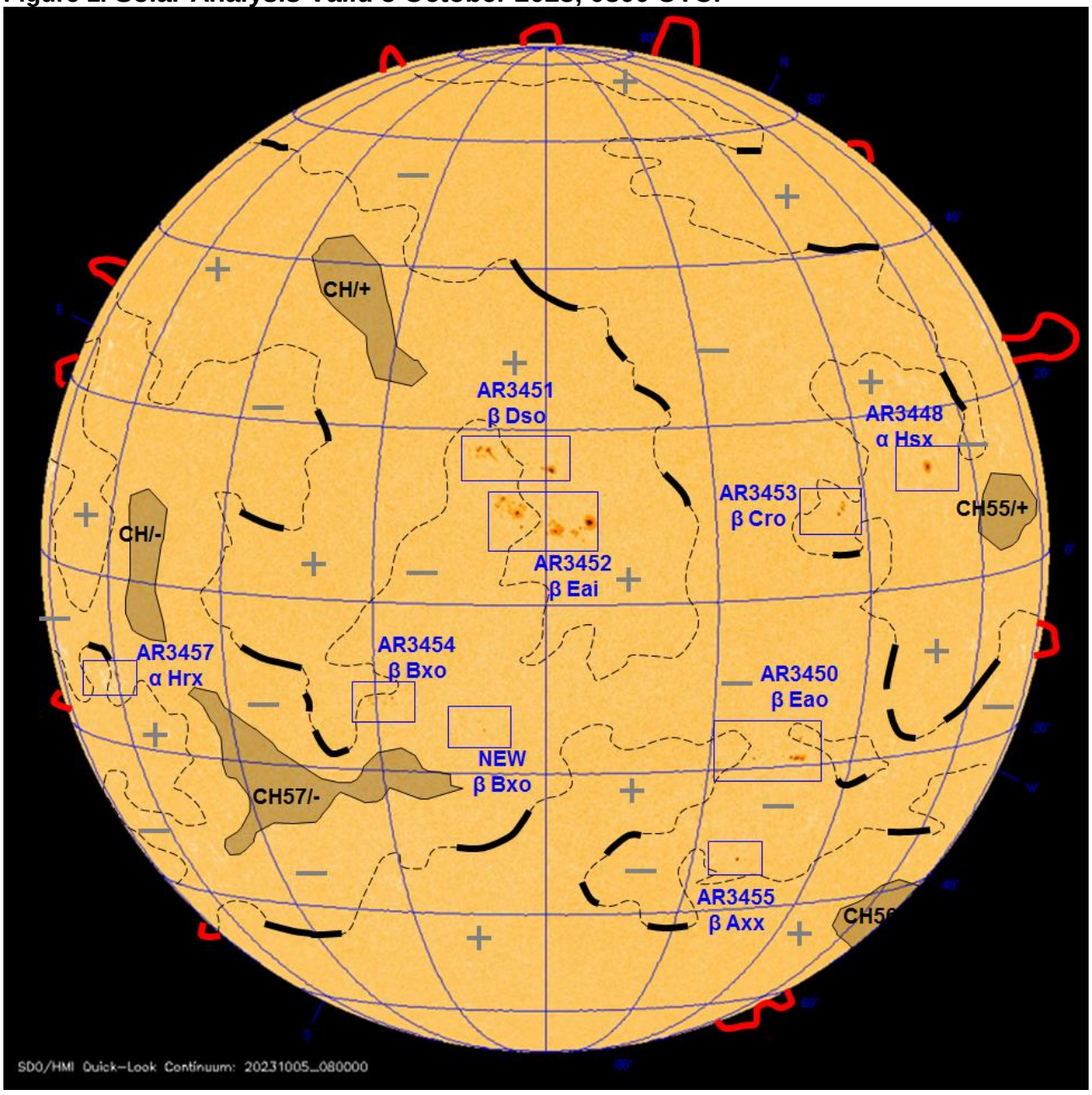
Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is most likely to remain at background levels, with a very low risk of enhancements from the current

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

sunspots on the disc. High energy electron flux (greater than 2MeV) observed by GOES16 is forecast to be mostly at background levels, perhaps rising later in the period although this is low confidence. Electron fluence is most likely to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 5 October 2023, 0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Geomagnetic Storms:

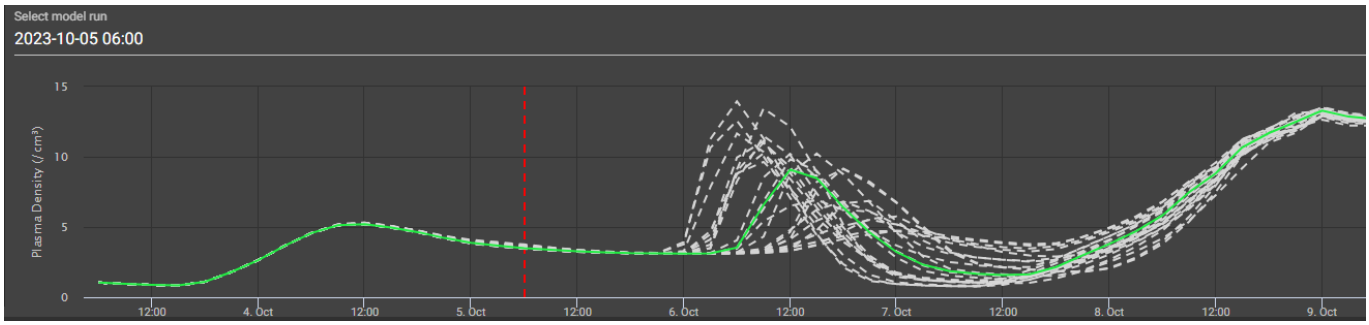
A C-class flare with associated coronal dimming and small eruption from AR3450 starting at 02/1554 UTC may have resulted in a faint, rather slow Earth-directed CME. Confidence is low to moderate in both the likelihood of this feature reaching Earth, and in the timing of any arrival. This may arrive at Earth either late on Day 1 (05 Oct) or more likely in the first half of Day 2 (06 Oct). No other CMEs feature in the forecast. The fast wind associated with equatorial CH55/+ appears to have reached Earth with a small bump in solar wind levels and is behind ENLIL's expectations. Solar winds will probably drift back down towards slow-ambient levels in the next 24 hours with little significant change envisaged thereafter, as no significant high-speed stream enhancements are forecast to affect Earth. Geomagnetic activity is expected to be mostly Quiet to Unsettled. This may become Active should the aforementioned CME arrive, with a slight chance of a G1/Minor Storm interval on Day 2 (6 Oct).

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	15	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
03/0108	Partial	AR3450	South centre disc	445 km/s	06/0600 UTC	Low to moderate confidence

Figure 2: MOSWOC Enlil ensemble, showing a possible CME arrival on 06 October.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

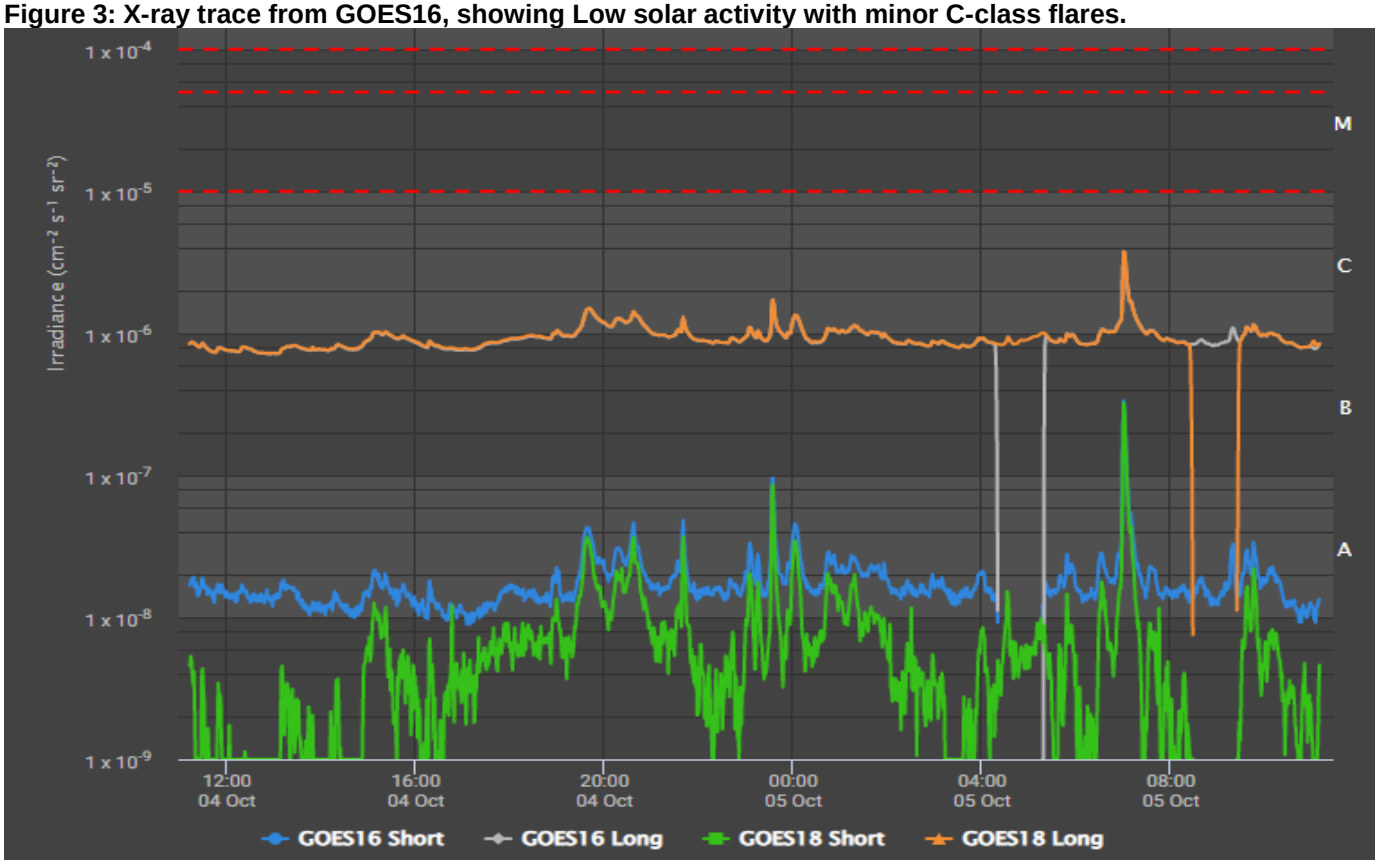
© Crown Copyright 2023. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

Nine sunspot regions feature on the current visible disc. The largest remains AR3452 (Eai/Beta) and this is now positioned centre disc, however it still has a fairly straightforward magnetic structure. AR3451 (Dso/Beta) just to the north of AR3452 shows some minor penumbra on the trailing spots. AR3450 (Eao/Beta in the southwest has shown little overall change in recent hours. The other regions appear mostly small and simple at the present time. Seismic signatures of the sun's far-side suggest that one or more active regions may rotate onto the Earth-facing disc during the period. These could include returning regions that left the visible disc around a fortnight ago. Recent CME activity suggests some level of sunspot activity and this might influence the flare probabilities in the coming days. Until these regions become visible however, it is difficult to assess the likely level of any increase. One of these regions is starting to show on the northeast limb with one small spot. Low solar activity is forecast to continue, with a chance of isolated M-flares, these most likely from AR3450 and perhaps more likely from AR3452.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: X-ray trace from GOES16, showing Low solar activity with minor C-class flares.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at background levels. There is a slight increase in risk as AR3450, AR3451 and AR3452 progress westwards to a more favourable position on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16, is currently at background levels. Given that the high speed stream from CH55/+ gave a muted response to solar winds then any increase in electron flux in the short term seems unlikely. In addition, should the 02 Oct CME arrive at Earth, this is likely to suppress flux levels in the short term. If the CME does arrive, then a subsequent increase in flux levels is possible later in the period on Days 3 and 4 (07-08 Oct). This is low confidence, however. The associated 24 fluence is expected to remain below the Active threshold throughout the period, perhaps with a slight increase towards the end of the period. REFM forecasts appear to be giving good guidance at this time.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: High energy electrons at GEO from GOES and Met Office REFM showing below Active trend, which is reasonable guidance

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.